Forest Health Protection
Pacific Southwest Region

Date: November 9, 2012

To: Sherry Tune, Forest Supervisor, Mendocino National Forest

Subject: Trip report of insect activity in the Mill Fire (FHP Report N12-06)

At the request of Chad Atwood, Grindstone District Silviculturist, a field evaluation of the Mill Fire was conducted on October 4, 2012. The objectives were to consider the current stand conditions and discuss use of the *Marking Guidelines for Fire-injured Trees in California* (CA. Report # RO-11-01) to determine the likelihood of individual trees suffering mortality after the fire. Sherry Tune, Nancy Mulligan, Chad Atwood, Gary Urdahl, Eduardo Olmedo, Jeanette Williams, Ken Wysocki, Linda Agerer, Nick Bunch, Vicki Stoll, Tucker Sierzega, Jason Cushman (Mendocino NF), Rick Svilich, Ryan Hadley, Rick Costic, Dee Sanders, Steve Brink (AFRC) and Cynthia Snyder (FHP) were in attendance.

Background

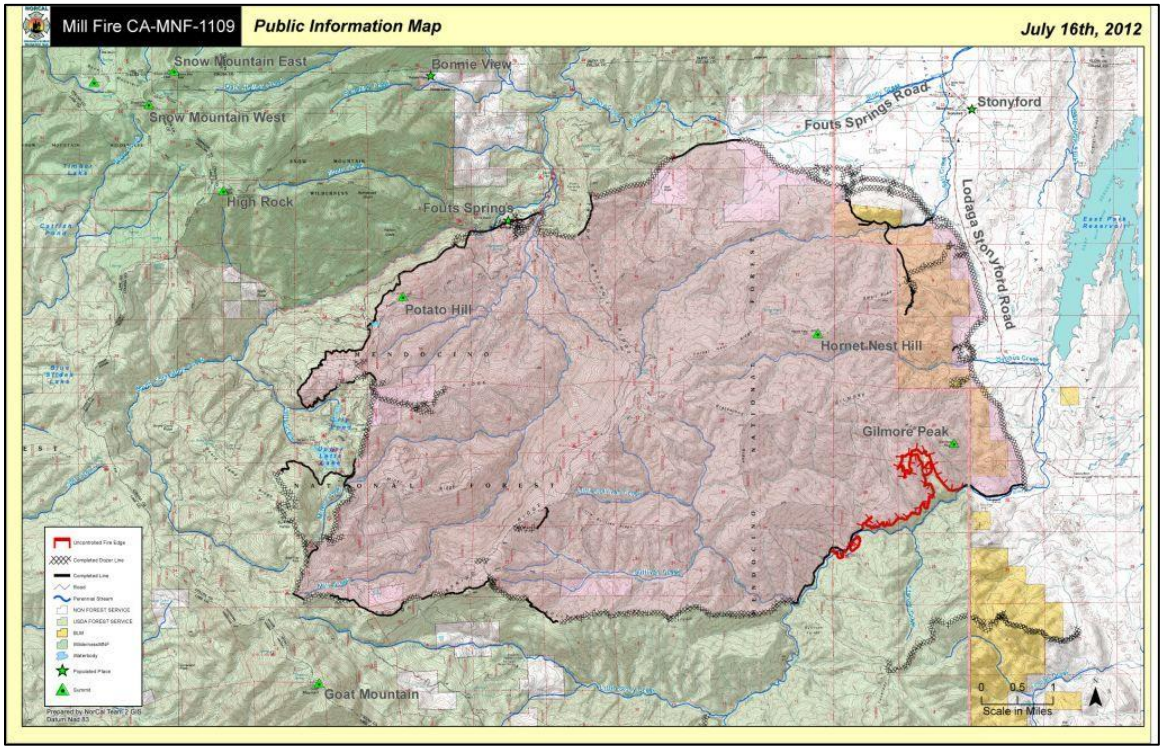

Figure 1. Public Information map of Mill Fire boundary on the Mendocino National Forest from the Mendocino NF website.

NORTHERN CALIFORNIA SHARED SERVICE AREA
3644 AVTECH PARKWAY, REDDING, CA 96002
(530) 226-2437

Cynthia Snyder
clsnyder@fs.fed.us

Pete Angwin
pangwin@fs.fed.us

The Mill Fire started on July 7, 2012 near the Mill Valley Campground, Colusa County approximately ten miles west of Stonyford, and grew to approximately 350 acres the first day. The fire spread to the north and east encompassing the Fouts Springs, Bonnie View and Board Camp communities and the highly-used Stonyford OHV trail systems and the Mill Valley, Mill Creek and Letts Lake Campgrounds. Terrain and wind dominated the active fire behavior, with spotting a half mile ahead of the fire and a running crown fire. The fire burned in heavy brush, pine-dominated and mixed conifer forest. The fire was considered to be 100% contained on July 18, 2012 after burning a total of 29,502 acres in the Mendocino National Forest (figure 1).

The planning area encompasses these same 29,502 acres of public and private land, some of which lies within a Wildland-Urban Interface Defense Zone near the communities of Stonyford, Fouts Springs, Bonnie View and Board Camp. Forest resources affected include: Stonyford Recreation Area, Big Springs Picnic Area, Cedar Camp Campground, Davis Flat Campground, Dixie Glade Campground, Fouts Campground, Gray Pine Group Campground, Letts Lake Campground, Little Stony Campground, Mill Creek Campground, Mill Valley Campground, Nail Track OHV Play Area, North Fork Campground, Old Mill Campground, South Fork Campground and the Wolf Creek Visitor Station. The planning area is accessed primarily via the M10 Road. Land management designations within planning area also include Riparian Reserve, Managed Late Successional Area (LSR), and Matrix.

Wildfire and Bark Beetles

Following wildfires, land managers need to determine, to the extent possible, which trees are likely to succumb to fire injury and which will survive. It is essential that assessments are made in a timely manner to support restoration efforts. Recent research and development of the *Marking Guidelines for Fire-injured Trees in California* (Report #RO-11-01, Smith and Cluck, May 2011) provide prognoses of tree survival, specific to California conifers, so that appropriate management responses to fire mortality are more effective. These guidelines are supported by local research and specific to California site conditions.

In some situations, there is a high likelihood of bark beetles infesting fire-weakened trees (Parker et al. 2006). Sub-lethal heating of cambium can stress trees, which then are more susceptible to bark beetle attack. Bark beetle outbreaks following wildfires are not unprecedented, but neither are they certain. In region 5, bark beetle activity in fire-injured trees is not likely to result in a population buildup that will subsequently spread into adjacent unburned stands at a significant level (Cluck, pers. comm.). Based on past observations of fires in California by FHP personnel, the buildup of bark beetles within burned areas has rarely resulted in increased attacks in adjacent unburned stands. When this has occurred, mortality has been restricted to individual trees and small stands that were directly adjacent to the fire perimeter and were generally in an unhealthy condition due to overstocking and drought.

Low tree vigor and cambium injury increase the likelihood of mortality. Trees with both high levels of foliage scorching and moderate to severe cambium kill are more likely to

die from bark beetle attacks. A fire-injured tree's susceptibility to bark beetles is determined by: amount of injury, populations of bark beetles in the vicinity, and the pre-fire tree/stand susceptibility to bark beetle attack (due to density, drought, etc.).

Observations

Fire-injuries sustained by trees within the Mill Fire are typical for most mixed severity fires in Northern California, ranging from light heat scorching of crowns and light basal charring to complete consumption of foliage and severe cambial kill. Fire caused crown and bole injuries within the Mill Fire vary by site, species and tree diameter. There are also areas of complete crown consumption of all trees species scattered throughout the fire area.

Pre-fire conditions were primarily overstocked through most areas, one notable exception being the fuel break at the top of the Trough Spring Ridge. This fuel break was thinned in 2007 to 25% max SDI, approximately 90 sq.ft./ac. conifers and 10 sq.ft./ac. hardwoods leaving about 33% canopy cover. In this area the fire "laid down" (went from the tree tops to the ground) and burn severity was much lower than the unthinned stands just below the road (figure 2). The fire severity map reveals areas of mixed severity surrounding large expanses of very high severity typical of many fires in California. The majority of the highest severity was reported by fire crews to have occurred in LSR. The LSR stands that we visited were mixed conifer dominated by ponderosa pine. Wildlife staff described it as possible foraging habitat, but not nesting/roosting habitat. Aerial survey maps indicate that there was no mortality in the fuel break area prior to the fire. However, scattered mortality, attributed to a variety of bark beetles and wood borers, was found within and surrounding the LSR.

Figure 2. Comparison of thinned fuel break with many green trees and unthinned unit directly across the road shows high degree of mortality due to scorch.

On the initial visit, we looked at stands in Matrix, Recreational Use and Late Successional Reserve land use classifications. There was very little bark beetle activity occurring in any of them. This may have been due to the limited amount of time between the fire and the visit or perhaps due to the late timing of the fire, after peak beetle flight periods for some bark beetle species.

Figure 3. Burned stand in Late successional Reserve portion of Mill Fire.

There was some evidence of flatheaded wood borers (Family: Buprestidae) in trees with severe cambium damage. These would have most likely arrived as the fire was still burning. Fire severity was mixed with large expanses of high severity surrounded by mixed moderate and low severity. The greatest concentration of high severity was found in the LSR with some areas having many continuous acres of 100% crown scorch.

Figure 4. Western pine beetle pitch-outs and successful attacks on ponderosa pine.

The LSR acres were often the densest and, in most cases, the most severely burned except for acres of brush in the low elevation hills surrounding the community of Stonyford. The pre-fire density put the primarily pine-dominated stands at an elevated risk of bark beetle-caused mortality prior to the fire and may increase the likelihood of post-fire bark beetle attack (for trees that survive the effects of direct fire injury).

Matrix and Recreational acres were also observed to have mixed fire severity with areas of the highest severity coinciding with areas of highest density. Fire injury was high in many area and all recreational trails were closed to the public at the time of the visit.

On a subsequent visit on October 22, western pine beetle, *Dendroctonus brevicomis*, was found infesting ponderosa pine at OHV trails approximately ½ mile north east of the Mill Valley Campground and mountain pine beetle, *D. ponderosae*, was found infesting sugar pines near road 17N14 approximately 1 mile south of Upper Letts Lake, both in areas of moderate to severe scorching. Red turpentine beetle, *D. valens*, was also found in ponderosa pine, but only in scattered trees.

Hazard Trees

It should be noted that the Region 5 Hazard Tree Guidelines (Report #RO-12-01, Angwin et al, April 2012) should be incorporated into marking guidelines developed for this area

due to the very popular OHV trail system and associated campgrounds. These Guidelines state that a Hazard Tree includes dead or dying trees, dead parts of live trees or unstable live trees that are within striking distance of people or property having the potential to cause property damage, personal injury or fatality in the event of a failure. This would include dead or dying trees that would otherwise meet the previous guidelines.

Figure 5. High severity burn surrounding one of the high-use OHV routes affected by the Mill Fire.

Discussion

A complex of factors is involved in any one tree's survival after wildfire, including pre-fire physiological condition, an array of abiotic site factors, pre-fire beetle pressure and interactions between these. We may never unfailingly predict either post-fire survival or death for fire-injured trees. But reasonable estimates, sufficient for most management decisions, are possible if measurable parameters, such as crown scorch and crown kill (Hood et al. 2007, Hood et al. 2010, Wolley et al. 2011) are adequately considered.

In the case of late-season fires, such as the Mill Fire, there are two sets of guidelines that may be appropriate for use in the ponderosa pine-dominated stands depending on timing of the evaluations. The percent crown length scorched guidelines, without red turpentine beetle, may be implemented this year because the buds had not yet formed and level of crown scorch may point to crown kill, red turpentine beetles may have already had peak flight and may not provide a greater amount of certainty. Or the Forest may opt to wait

until next year to evaluate the fire-injury and use the percent crown length killed guidelines with or without red turpentine beetle depending on the time of year in relation to beetle flight. Other species, such as Douglas-fir, incense cedar, sugar pine and true firs can be evaluated any time after fire injury. All evaluations should be completed before the beginning of the second post-fire winter.

By providing a range of probability of mortality (Pm) levels, the guidelines afford the land managers options to meet the post-fire management objectives. The selection of the probability of mortality level for specific areas should take into consideration the following factors:

- Burn severity pattern
- Management objectives and desired future conditions
- Post-salvage fuels objectives
- Snag requirements
- Economics and logistics including number of harvest entries allowed, method of harvest, reforestation plans and NEPA process
- Hazard trees
- Pre-fire stand conditions including density, drought and beetle activity

After identifying the objectives, conditions and requirements for projects in the Mill Fire, land managers should continue consultation with Forest Health Protection staff, as well as other land managers who have implemented projects using these guidelines, to assist with selecting probability of mortality levels which will best meet their objectives.

The Regional Hazard Tree Guidelines should be incorporated into any marking guidelines developed for recreation areas and roadsides such as the high-use OHV trails and campgrounds affected by the Mill Fire. The Hazard Tree Guidelines discuss the types of structural defects and insects and diseases that are associated with hazard trees. In order for a tree to be considered a Hazard Tree it must meet certain criteria and most importantly be within striking distance of people or property (including roads). The level of danger is determined by a qualified individual using a combination of the value of the target and the defects of the tree. For example, a tree that shows signs of decay that is located next to a low use road will likely be considered much less of a danger than the same tree located next to a developed campsite. Knowledge of previous tree failures and unique site conditions, e.g. wet soils, high wind area, and presence of root disease, can help make these determinations.

There is no accurate method of predicting when fire-injured and fire-killed trees will fail; any tree can fall at any time due to a variety of factors. Fire-killed and fire-injured trees have higher probabilities of failure than uninjured and healthy trees.

If you have any questions regarding this report and/or need additional information please contact Cynthia Snyder at (530) 226-2437.

/s/ Cynthia Snyder

Cynthia Snyder
Entomologist
Northern California Shared Service Area

CC: Frank Aebly, Nancy Mulligan, Chad Atwood, Gary Urdahl, Sheri Smith, Pete Angwin, Phil Cannon

Appendix

Western pine beetle

The western pine beetle, *Dendroctonus brevicomis*, breeds in the main bole of living ponderosa pine larger than about 8 inches dbh. Normally it breeds in trees weakened by drought, overstocking, root disease, dwarf mistletoe or fire. Adult beetles emerge and attack trees continuously from spring through fall. Depending on the latitude and elevation, there can be from one to four generations per year.

Evidence of Attack

Initial attacks are made about mid-bole and subsequent attacks fill in above and below. Pitch tubes are formed on the tree trunk around the entry holes. The pitch tubes are red-brown masses of resin and boring dust. Relatively few, widely scattered, white pitch tubes usually indicate that the attacks were not successful and that the tree should survive. Pheromones released during a successful attack attract other western pine beetles. Attacking beetles may spill over into nearby apparently healthy trees and overwhelm them by sheer numbers.

Life Stages and Development

These beetles pass through the egg, larval, pupal and adult stages during a life-cycle that varies in length dependent primarily upon temperature. Adults bore a sinuous gallery pattern in the phloem and the female lays eggs in niches along the sides of the gallery. The larvae are small white grubs that first feed in the phloem and then mine into the middle bark where they complete most of their development. Bluestain fungi, introduced during successful attacks, contribute to the rapid tree mortality associated with bark beetle attacks.

Conditions Affecting Outbreak

The availability of suitable host material is a key condition influencing western pine beetle outbreaks. In northeastern California, drought stress may be the key condition influencing outbreaks. When healthy trees undergo a sudden and severe moisture stress populations of western pine beetle are likely to increase. Healthy trees ordinarily produce abundant amounts of resin, which pitch out attacking beetles, but when deprived of moisture, stressed trees cannot produce sufficient resin flow to resist attack. Any condition that results in excessive demand for moisture, such as tree crowding, competing vegetation or protracted drought periods; or any condition that reduces that ability of the roots to supply water to the tree, such as mechanical damage, root disease, or soil compaction, can cause moisture stress and increase susceptibility to attack by the western pine beetle. Group kills do not typically continue to increase in size through successive beetle generations as is typical with Jeffrey pine beetle. Rather, observations indicate that emerging beetles tend to leave the group kill area to initiate new attacks elsewhere. Woodpeckers and predaceous beetles are natural control agents when beetle populations are low.

Mountain pine beetle

The mountain pine beetle, *Dendroctonus ponderosae*, attacks the bole of ponderosa, lodgepole, sugar and western white pines larger than about 8 inches dbh. Extensive infestations have occurred in mature lodgepole pine forests. Group killing often occurs in mature forests and young overstocked stands of ponderosa, sugar and western white pines.

Evidence of Attack

The first sign of beetle-caused mortality is generally discolored foliage. The mountain pine beetle begins attacking most pine species on the lower 15 feet of the bole. Examination of infested trees usually reveals the presence of pitch tubes. Pitch tubes on successfully infested trees are pink to dark red masses of resin mixed with boring dust. Creamy, white pitch tubes indicate that the tree was able to "pitch out" the beetle and the attack was not successful. In addition to pitch tubes, successfully infested trees will have dry boring dust in the bark crevices and around the base of the tree. Attacking beetles carry the spores of blue-staining fungi which develop and spread throughout the sapwood interrupting the flow of water to the crown. The fungi also reduces the flow of pitch in the tree, thus aiding the beetles in overcoming the tree. The combined action of both beetles and fungi causes the needles to discolor and the tree to die.

Life Stages and Development

The beetle develops through four stages: egg, larva, pupa and adult. The life cycle of the mountain pine beetle varies considerably over its range. One generation per year is typical, with attacks occurring from late June through August. Two generations per year may develop in low elevation sugar pine. Females making their first attacks release aggregating pheromones. These pheromones attract males and other females until a mass attack overcomes the tree. The adults bore long, vertical, egg galleries and lay eggs in niches along the sides of the gallery. The larvae feed in mines perpendicular to the main gallery and construct small pupal cells at the end of these mines where they pupate and transform into adults.

Conditions Affecting Outbreaks

The food supply regulates populations of the beetle. In lodgepole pine, it appears that the beetles select larger trees with thick phloem, however the relationship between beetle populations and phloem thickness in other hosts has not been established. A copious pitch flow from the pines can prevent successful attack. The number of beetles, the characteristics of the tree, and the weather affect the tree's ability to produce enough resin to resist attack. Other factors affecting the abundance of the mountain pine beetle include nematodes, woodpeckers, and predaceous and parasitic insects. As stand susceptibility to the beetle increases because of age, overstocking, diseases or drought, the effectiveness of natural control decreases and pine mortality increases.

References

Angwin, P. A., D.R. Cluck, P.J. Zambino, B.W. Oblinger and W. C. Woodruff . 2012. *Hazard Tree Guidelines For Forest Service Facilities and Roads in the Pacific Southwest Region*. US Forest Service, Forest Health Protection, Region 5, Report # RO-12-01. 36 p.

Hood, S.M., S.L. Smith, and D.R. Cluck. 2010. Predicting mortality for five California conifers following wildfire. Forest Ecology and Management. 260: 750-762.

Hood, S.M., S.L. Smith, and D.R. Cluck. 2007. Delayed conifer tree mortality following fire in California. In: Powers, Robert F., tech. editor. Restoring fire-adapted ecosystems: proceedings of the 2005 national silviculture workshop. Gen. Tech. Rep. PSW-GTR-203, Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture: p. 261-283.

Parker, T.J., K.M. Clancy and R.L. Mathiasen. 2006. Interactions among fire, insects and pathogens in coniferous forests of the interior western United States and Canada. Agricultural and Forest Entomology, 8, 167–189.

Smith, S.L. and D.R. Cluck. 2011. Marking guidelines for fire-injured trees in California. US Forest Service, Forest Health Protection, Region 5, Susanville, CA. Report # RO-11-01. 13 p.

Wooley, T., D.C. Shaw, L.M. Ganio and S. Fitzgerald. 2011. A review of logistic regression models used to predict post-fire tree mortality of western North American conifers. Int. J. Wild. Fire, 21, 1-35.